

IN THE UNITED STATES DISTRICT COURT FOR THE
NORTHERN DISTRICT OF OKLAHOMA

W. A. DREW EDMONDSON, in his)
capacity as ATTORNEY GENERAL)
OF THE STATE OF OKLAHOMA and)
OKLAHOMA SECRETARY OF THE)
ENVIRONMENT C. MILES TOLBERT,)
in his capacity as the)
TRUSTEE FOR NATURAL RESOURCES)
FOR THE STATE OF OKLAHOMA,)

Plaintiff,)

vs.)

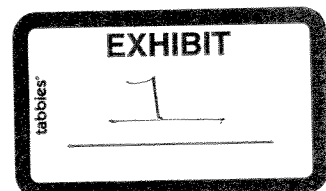
4:05-CV-00329-TCK-SAJ

TYSON FOODS, INC., et al,)

Defendants.)

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THE VIDEOTAPED DEPOSITION OF
BRIAN HAGGARD PhD, produced as a witness on
behalf of the Plaintiff in the above styled and
numbered cause, taken on the 16th day of April,
2009, in the City of Fayetteville, County of
Washington, State of Arkansas, before me, Lisa A.
Steinmeyer, a Certified Shorthand Reporter, duly
certified under and by virtue of the laws of the
State of Oklahoma.



BRIAN HAGGARD, PhD, 4-16-09

20

1 Q Okay. Are there any private sources of
2 funding that you've used or rely on?

3 A I've received one grant from U. S. Poultry &
4 Egg.

5 Q When was that?

08:56AM

6 A Let me look, please.

7 Q Sure.

8 A 2005.

9 Q And was it associated with a particular work?

10 A Yes, it was.

08:56AM

11 Q Is that the pelleting poultry litter
12 environmental consequences project?

13 A Yes, sir.

14 Q And is that the only one then that you know?

15 A Yes, sir.

08:56AM

16 Q Okay. Let me hand you what's been marked as
17 Exhibit No. 2 and ask you to look at that and then
18 tell the court if you recognize that document.

19 A Yes, sir, I do.

20 Q Tell the court what is that document.

08:56AM

21 A This is the publication of Bree Menjoulet, who
22 is a graduate student of Dr. Kris Brye, and I served
23 on her masters committee.

24 Q Are you considered one of the authors of this
25 study?

08:57AM

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21

1 A Yes, sir. I am the fourth author.

2 Q Okay. Did you read and approve the content of

3 the paper prior to its publication?

4 A Yes, sir.

5 Q All right. Were the opinions, findings and 08:57AM

6 conclusions made in the paper accurate and true at

7 the time they were made?

8 A Yes, sir.

9 Q All right. Are there any facts or events that

10 would cause you to change any opinions or findings 08:57AM

11 or conclusions found in this paper today?

12 A I'm not aware of any.

13 Q Okay. Is this a paper that went through a

14 peer review process? Let me put it this way: Other

15 than the committee that would oversee the student in 08:57AM

16 preparing her thesis, is there any other peer review

17 that applied to this paper?

18 A Yes. It's a blind-blind review in the Journal

19 of Environmental Quality.

20 Q Thank you.

21 A Or single blind review, I believe.

22 Q Okay. For the purposes or benefit of the

23 court, tell generally what a blind review would be

24 in providing --

25 A Where the authors who do not know who is 08:58AM

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BRIAN HAGGARD, PhD, 4-16-09

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1 providing the technical review.

2 Q All right, they give feedback, though, and
3 it's unidentified?

4 A Yes. It's identified as Reviewer No. 1, 2, 3,
5 depending upon how many technical reviews there
6 were. 08:58AM

7 Q I'm going to look at the abstract of the
8 paper, and a couple or three sentences down it says,
9 the objective of this study was to evaluate the
10 effect of broiler litter application rate on runoff 08:58AM
11 water quality in response to natural precipitation.
12 Is that a fair statement of what was done for this
13 study?

14 A Yes, sir.

15 Q All right. Where was the study conducted? 08:59AM

16 A At the Arkansas Agricultural Research and
17 Extension Center here in Fayetteville, Arkansas.

18 Q Okay. Is that the same thing that's referred
19 to as the Savoy Experimental Station?

20 A No, sir. 08:59AM

21 Q Okay. So there are two separate stations?

22 A Yes, sir.

23 Q What was used in the study; did you have study
24 plots?

25 A We had small plots. 08:59AM

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23

1 Q And basically just describe what those are for
2 the court, if you would, please?

3 A They're -- they are a certain size, sometimes
4 five by twenty feet, and they are bermed at each end
5 either with metal or with wood to hydrologically
6 isolate a particular land area. At the down slope
7 end there's a runoff trough that's used to collect
8 the runoff water.

08:59AM

9 Q Are these plots -- have they to your knowledge
10 been used in prior studies?

08:59AM

11 A Yes, sir, I believe they were.

12 Q And do you remember what studies they might
13 have been used for?

14 A Not the particular studies, but it would have
15 been studies conducted by Dr. Daniels and Dr. Dwayne
16 Edwards back in the early to mid '90s.

09:00AM

17 Q Okay. Other than the -- I'm not sure what you
18 call it -- the flute at the end to catch runoff, are
19 there any other types of instrumentation applied on
20 plots to measure either water flow or other
21 characteristics?

09:00AM

22 A When working with the natural precipitation as
23 of this case, they had a covered bottle that was
24 attached to the end of the flume where the runoff
25 water was collected, and that's where they collected

09:00AM

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24

1 their water samples.

2 Q Okay. Any other type of instrumentation used
3 besides that?

4 A Not in this study.

5 Q Okay. Tell the court what kind of waste was 09:00AM
6 applied on these plots that was being studied.

7 MR. BURNS: Object to form.

8 A Poultry litter was applied to these plots.

9 Q Okay, and what was the source of the poultry
10 litter that was used? 09:01AM

11 A I am not aware of where exactly where it came
12 from.

13 Q Okay. Do you know what the rate of
14 application was in the study?

15 A I would have to review the document. 09:01AM

16 Q All right. Why don't you look at that?

17 A Based upon the abstract, the application rates
18 were zero, 5.6 and 11.2 megagrams per hectare.

19 Q And would relate to approximately two and a
20 half to five tons of pounds per acre application 09:01AM
21 rate?

22 A I would have to do the conversions but --

23 Q I should not say pounds. Actually it would be
24 approximately two and a half to five tons per acre
25 application rate? 09:01AM

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25

1 A If that's the right conversion rate, yes, sir.

2 Q What do you know to be the conversion rate?

3 A I don't off the top of my head.

4 Q That's all right. I have to do the same. Do

5 you know why those rates of application were chosen? 09:02AM

6 A No, other than to bracket two different rates

7 and then have a control at zero the experimental

8 design of the study was set up for that I was

9 involved in.

10 Q And it indicates in the paper, Exhibit 2, that 09:02AM

11 the applications were applied annually for a period

12 of approximately four years, April of '03 through

13 May of '06. Is that all the application that

14 occurred to your knowledge, once annually?

15 A Once annually, yes, sir. 09:02AM

16 Q Okay. I also note in the paper there was

17 historical rainfall actually collected, the data for

18 historical rainfall for the area; is that correct?

19 A Historical rainfall?

20 Q Yeah, average rainfall per year. 09:03AM

21 A Yes. I believe they looked at data that's

22 available at the experiment station.

23 Q Okay, and do you know, sir, what is the

24 average rainfall for that area?

25 A I'd generally say it's an average of about 40 09:03AM

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1 to 50 inches per year.

2 Q Do you know whether or not through the study
3 period that the average was in fact occurring over
4 the four-year period?

5 A No, I do not.

09:03AM

6 Q Okay. Let's look at Page 1008 of the paper
7 under Results and Discussions.

8 MR. ELROD: What page, Rick?

9 MR. GARREN: 1008.

10 Q I apologize. There was a quote I wanted you
11 to read and look at, and I can't seem to see where I
12 put it, where it's located. Oh, go to the next page
13 and under the Vegetative Response, the very last
14 sentence in that paragraph heading where it says,
15 though not formally compared, numerically lower DM
16 yields in year three were likely the result of the
17 37 percent below average precipitation that occurred
18 in that year of 2006 or in that year. Do you see
19 that, the very last sentence?

09:04AM

09:04AM

20 A Very last sentence?

09:05AM

21 Q Yes. Do you see where there it reports there
22 was a 37 below percent average precipitation that
23 occurred that year; do you see that statement?

24 A Yes, sir.

25 Q So at least in one year there was a below

09:05AM

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1 average or somewhat below average of typical
2 rainfall?

3 A Yes, sir.

4 Q Okay. Do you know what effect, if any, the
5 lower rainfall had in this study?

09:05AM

6 A Not specifically without reading through the
7 study again.

8 Q Okay. Tell the court, if you would, please,
9 what -- generally what chemicals or items are being
10 studied in this research.

09:05AM

11 A In this study, the graduate student looked at
12 the concentrations of various elements that are
13 measurable by ICO inductively coupled plasma optical
14 emission spectrometry. It's a machine that's able
15 to analyze about 20 elements for us at once, as well
16 as nitrogen and phosphorus and then some of the soil
17 parameters.

09:06AM

18 Q So soluble nutrients would be one example
19 perhaps?

20 A Yes, sir, in a general sense.

09:06AM

21 Q And metals?

22 A Yes, sir.

23 Q Okay. In this study, were runoff losses
24 different for the control versus the litter-applied
25 plots; do you know?

09:06AM

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1 A Again, I would have to -- it has been a while
2 since I read this. I would have to reread.

3 Q All right. Do you know, sir, whether or not
4 the plots which were litter applied reflected
5 greater runoff of nutrient concentrations than those
6 that were not applied?

09:06AM

7 A I would have to reread the study to see which
8 plots had the highest runoff volumes.

9 Q You don't recall generally yourself here
10 today?

09:07AM

11 A No, sir, I don't.

12 Q Let's look back in the abstract then which is
13 probably easier to find and near the bottom, if I
14 can point to an area where it starts, the four-year
15 flow-weighted main -- or mean; do you see that
16 there?

09:07AM

17 A The flow-weighted concentrations?

18 Q Yes. Read where that starts to the end of the
19 sentence, and the four year FWM, which is
20 flow-weighted mean --

09:07AM

21 A Phosphorus concentration from the low litter
22 treatment was greater than that from the unamended
23 control.

24 Q All right. Does that refresh your
25 recollection of what occurred in the study?

09:07AM

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1 A Yes, sir. There were higher concentrations
2 from that plot than the control study.

3 Q Okay, and those concentrations were in this
4 case talking about phosphorus; is that right?

5 A Yes, sir.

09:08AM

6 Q Was any simulated rainfall used in this study
7 for the four-year period?

8 A No, sir.

9 Q So all of this is actual rainfall that's being
10 measured across these plots?

09:08AM

11 A Natural precipitation, yes, sir.

12 Q All right. Have you -- do you have experience
13 yourself with working in studies that used rainfall
14 simulations?

15 A Yes, sir.

09:08AM

16 Q Tell the court, if you would, what's the
17 purpose of using a rainfall simulator.

18 A A rainfall simulator gives the investigator
19 the ability to control how much rainfall each plot
20 receives.

09:08AM

21 Q Is there any objective in using a simulator to
22 comparing it to natural rainfall?

23 A Not in my mind, no, sir.

24 Q Okay. Is there any reason to -- well, is
25 there -- is it generally the intent to try and

09:09AM

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1 replicate natural rainfall events when using
2 simulators?

3 A No, sir.

4 Q Why would you not try and simulate or
5 replicate natural rainfall using the simulator?

09:09AM

6 A When I have personally used in the rainfall
7 studies we did, we ran between five and seven
8 centimeters per hour, which is very, very intense
9 storm event, because we want to generate runoff as
10 quickly as possible to speed the study along because
11 the majority of the time we are working with 28 or
12 more plots at one time.

09:09AM

13 Q Okay. So it's more of a convenience then in
14 order to get the runoff quicker; is that what you're
15 saying?

09:09AM

16 A It is, and it also would replicate being that
17 intense of a storm event, kind of a worst case
18 situation.

19 Q Is the study that we're seeing in Exhibit 2,
20 because it's natural rainfall, it's different in
21 what its objective is; is that a fair statement?

09:10AM

22 MR. BURNS: Object to form.

23 Q Let me put it this way: As compared to a
24 rainfall simulation that you just described, the
25 objective is different in this study in Exhibit 2;

09:10AM

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1 is that correct?

2 A This study evaluated runoff volumes and
3 nutrient loss under natural precipitation.

4 Q Did the results in this study, are they
5 different than what you observed in your work in 09:10AM
6 rainfall simulations?

7 A Just a second. I'm processing. Could you
8 rephrase the question one more time?

9 Q Yeah. Are the -- do the results in the study
10 in Exhibit 2, are they different than what you have 09:10AM
11 observed when using your rainfall simulation
12 studies?

13 A They are similar in that this study in Exhibit
14 2 showed increased concentrations after litter was
15 applied compared to the control, which is very 09:11AM
16 similar to what we see with the rainfall simulation
17 studies.

18 Q Are the amounts in the rainfall simulation
19 studies just greater because you have kind of
20 expedited the process and the amount of rain that 09:11AM
21 you're simulating?

22 A The plots are rained on more intensely, and we
23 generally get a higher percentage of runoff volume
24 coming off of those, yes, sir.

25 Q Based on your study, do you have an opinion 09:11AM

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1 whether the long-term runoff response to natural
2 precipitation is different than you find in your
3 experience with the rainfall simulators?

4 A Could you ask the question one more time?

5 Q Yeah. Based on your experience and knowledge 09:12AM
6 and studies, do you have an opinion whether the
7 long-term runoff response to natural precipitation
8 is different than responses you've seen from your
9 simulation studies?

10 MR. VARADY: I'm going to renew my 09:12AM
11 objection. You can answer to the extent you can
12 understand it or follow the question.

13 A It is -- the obvious difference is that we are
14 artificially raining on the plots compared to --
15 generally at one specified intensity compared to 09:12AM
16 natural rainfall, which occurs at a variety of
17 intensities over a time scale.

18 Q Okay. Let's go to Page 1012 of this Exhibit
19 2. Let's just start at the top right-hand column.
20 The very first sentence up there says, all annual 09:13AM
21 flow-weighted mean and its total dissolved
22 phosphorus concentrations from each treatment, Table
23 5, exceeded the minimum P concentrations of .002 to
24 .09 megagrams per liter to the one power required
25 for algae growth or algae growth. Tell the court 09:13AM

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1 what that means in layman terms. What are you
2 finding there in this study based on that statement?

3 A The phosphorus concentrations in the runoff
4 water were greater than that generally observed in
5 streams.

09:13AM

6 Q What does it mean when it says that they
7 exceeded the minimum concentrations required for
8 algae growth; what does that mean?

9 A I really don't -- well, there are studies that
10 I'm aware of but that I have not conducted myself
11 that suggest that algal growth continues up between
12 those range of concentrations listed in that paper,
13 from .002 to .09 milligrams per liter.

09:14AM

14 Q So is the water that's running off these plots
15 in this study, they contain P concentrations great
16 enough to promote algae growth; is that what that
17 says?

09:14AM

18 MR. BURNS: Object to form.

19 A That statement says that those concentrations
20 are greater than that range that we just discussed.

09:15AM

21 Q Okay. Go down another -- into the next
22 sentence and it does say -- past the point where it
23 says Table 2 in the right-hand column where it says
24 Table 2 --

25 A Okay.

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1 Q -- it says, it is not surprising that despite
2 not having received litter additions for at least
3 four years previously, the unamended control still
4 had measurable P in the runoff. Why is that is not
5 surprising; can you tell what that means?

09:15AM

6 A There is phosphorus stored within the soil
7 that can be lost into runoff waters.

8 Q All right. It then goes on to say, thus, it
9 is apparent that runoff water quality can be
10 affected and eutrophication of surface waters could
11 still potentially occur years after cessation of
12 broiler litter applications. Again, what does that
13 mean in layman's terms, if you would, please?

09:15AM

14 A Because of the phosphorus that can be stored
15 in soils, you can still have increased phosphorus
16 concentrations in the runoff water.

09:16AM

17 Q All right. Based on your knowledge,
18 experience, research and review of published
19 literature, do you have an opinion whether or not
20 the -- that some or all of the nutrients and trace
21 metals as were found in the poultry waste in this
22 study, found in the setting -- let me ask it this
23 way differently: The phosphorus concentrations and
24 metals that are described in this report that run
25 off the studied plots, do those chemicals reach

09:16AM

09:17AM

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1 streams and waters in the topography or geology that
2 you find typically as used in this study?

3 MR. BURNS: Object to form.

4 MR. VARADY: I'm going to renew my
5 objection at the outset that that's requesting a new
6 opinion not contained in the report. To the extent
7 you can understand the question or feel qualified to
8 response to it, go ahead.

09:17AM

9 A Specifically to these plots, most all the
10 runoff water was collected in the sampling bottles.

09:17AM

11 Q And I understand that. If these plots don't
12 have a collection bottle at the end to catch that
13 runoff, where does that runoff typically go in real
14 life in landscape?

15 MR. BURNS: Object to form.

09:17AM

16 MR. VARADY: I'm going to renew my
17 objections to the extent it asks for formation of a
18 new opinion.

19 A Runoff is going to move down slope.

20 Q And other than moving down slope, what happens
21 to it?

09:18AM

22 A It is very dependent upon what features are
23 down slope of that particular area.

24 Q Would infiltration be one option about what
25 could happen to that runoff?

09:18AM

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1 A Yes, sir.

2 Q Evapotranspiration, would that be another
3 possibility?

4 A Yes, sir.

5 Q And becoming just surface water runoff would 09:18AM
6 be a third; is that a fair statement?

7 A Yes, sir.

8 Q Are there any other processes that you're
9 aware of from your research and studies what would
10 happen to runoff from a field? 09:18AM

11 A Just keeping in context with the hydrologic
12 cycle, there is storage of water on the field as
13 well.

14 Q So there might be some ponding?

15 A Yes, sir. 09:18AM

16 Q Does that also possibly lead to further
17 infiltration or leaching, or can it?

18 A It's possible.

19 Q Okay. Let's look at Page 1010 and in the
20 lower right-hand corner under Flow-Weighted Mean 09:19AM

21 Concentrations title there's a sentence or two there
22 that says, except for P, which is phosphorus,
23 elevated concentrations of plant nutrients in runoff
24 are generally not considered environmentally or
25 ecologically harmful. However, trace metals in 09:19AM

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1 runoff potentially pose a greater environmental
2 threat. Is this your first experience with the
3 threat that you talk about from trace metals, this
4 study, or have there been others?

5 A I'm trying to think of the timing. There
6 have -- this might have been my first experience on
7 writing about trace metal loss, but there have been
8 other studies where we have measured trace metals in
9 extracts or in samples.

09:19AM

10 Q Tell the court, if you would, what you mean by
11 that these trace metals potentially pose a greater
12 environmental threat. What is what environmental
13 threat?

09:20AM

14 A It is not my area of expertise, but many trace
15 elements do have the potential to have toxic
16 effects.

09:20AM

17 Q Give me example of some of those trace
18 elements that would have a toxic effect.

19 A As an example, copper can have a toxic effect,
20 both at low concentrations if it's not there in
21 sufficient amounts, or at high concentrations.

09:20AM

22 Q Okay.

23 MR. ELROD: Rick, I have to interpose an
24 objection that this is outside the scope of
25 discovery.

09:20AM

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1 Q This study found high levels of iron coming
2 off; is that correct?

3 MR. BURNS: Object to form.

4 Q You'd have to look at it to recall?

5 A Yes, sir. I have not read this paper since it 09:21AM
6 was published.

7 Q Look at the abstract perhaps and
8 three-quarters of the way down it talks about
9 four-year flow-weighted mean Fe, iron,
10 concentrations in runoff losses were greater from 09:21AM
11 the high than from the low litter treatment,
12 unamended control. Does that refresh your
13 recollection of what was found in this study?

14 A Yes, sir.

15 Q And is iron a trace metal that can cause 09:21AM
16 environmental harm?

17 MR. BURNS: Object to form.

18 MR. VARADY: Do you mean as found in this
19 study, Mr. Garren?

20 MR. GARREN: Just as I've stated. 09:21AM

21 A I don't know hardly anything about the
22 toxicity of iron to be honest.

23 Q Okay. Can something be harmful to the
24 environment but not be toxic?

25 MR. BURNS: Object to form. 09:22AM

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1 MR. VARADY: I'm going to renew my
2 objection on that as well.

3 A I would need a more specific question.

4 Q Okay. Nonetheless, when the statement was

5 made in this report that except for P, elevated

09:22AM

6 concentrations of plant nutrients in runoff are

7 generally not considered environmentally or

8 ecologically harmful, was that true at the time you

9 made this statement?

10 A In relationship to the study?

09:22AM

11 Q Yeah.

12 A Yes.

13 Q And do you believe that that statement only

14 applies to this study or a broader application than

15 that?

09:22AM

16 A It's very dependent on what concentrations you

17 see, so it does apply to this study.

18 Q Okay. Is that statement, though, the very

19 first sentence on Page 1010 that we just read,

20 talking about the study alone or is it more

09:23AM

21 generally talking about what elevated P

22 concentrations are generally?

23 A Let me read to put it in context of the

24 paragraph.

25 Q Sure.

09:23AM

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BRIAN HAGGARD, PhD, 4-16-09

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1 A That could apply both.

2 Q To the study and more general?

3 A Yes, sir.

4 Q Okay. Let's skip over then to Page 1016, if

5 you would. At the very bottom, the very last part

09:24AM

6 of the summary and conclusions, there's a sentence

7 there I'd like to read and ask you about. However,

8 eliminating broiler litter application completely,

9 as represented by the control treatment in this

10 study, may still lead to years of nutrient and metal

09:24AM

11 enriched runoff, i.e., and we've got total dissolved

12 P, copper, chromium I believe, iron, manganese?

13 A Yes, sir.

14 Q Nickel and zinc, due to the soil's ability to

15 concentrate, retain and recycle nutrients and trace

09:25AM

16 metals near the soil surface. Was that a true

17 statement at the time this was written?

18 A Yes, sir.

19 Q Okay. Is that -- does statement as far as you

20 know today continue to be true?

09:25AM

21 A Yes, sir, because of the storage of certain

22 elements in soils.

23 Q Okay. Do you know what the history of the

24 control plot was in this study?

25 A I do not know the specific history, but it was

09:25AM

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1 involved in previous rainfall simulations for the
2 previous decade.

3 Q From that statement, do you believe it was
4 also perhaps not or had been also land applied with
5 poultry litter?

09:25AM

6 A I do not specifically know.

7 Q Okay. Are you aware of any studies that are
8 concerned with quantifying the length of time that
9 nutrients or metals continue to appear in runoff
10 from plots or fields?

09:26AM

11 A Not specifically.

12 Q Okay. Did you in this study measure any
13 subsurface runoff or leaching at the control plot?

14 A Not in relation to this study, but Mandy
15 Pirani, who is another graduate student of Dr.
16 Brye's, she did measure the volume of water
17 leaching.

09:26AM

18 Q And is that in any published papers at this
19 time?

20 A Yes, sir.

09:26AM

21 Q Do you recall when that was published?

22 A Let me go back and look at my resumT.

23 Q Sure.

24 A It should be listed there.

25 Q If you remember, it might be the authors

09:26AM

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1 besides Pirani.

2 A There was one paper published in 2006 and the
3 authors were Mandy Pirani, Kris Brye, Tommy Daniel,
4 myself, Edward Gbur and John Mattice.

5 Q Thank you very much.

09:27AM

6 A And there was a paper published in 2007 and
7 the authors were Mandy Pirani, Kris Brye, myself,
8 Tommy Daniel and John Mattice.

9 Q On Page 1012 of this paper it talks about the
10 topography at the site and in the right-hand column

09:27AM

11 about a third of the way down it says, the Karst
12 topography throughout the region in which this study
13 was conducted results in surface water, i.e., runoff
14 water, being hydrologically connected directly to
15 the groundwater, which serves as the drinking water
16 supply for many residents. Tell the court what that
17 is, meaning how are the surface water and
18 groundwater connected?

09:28AM

19 MR. BURNS: Object to form.

20 A Surface water and groundwater are connected
21 through infiltration through water movement through
22 the soil profile into the groundwater. The Karst
23 features, I'm not a Karst geologist, but they are
24 basically cracks or fractures that have gravel,
25 alluvial-type material in them that allow for water

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1 to move faster than it does through the soil
2 profile.

3 Q Okay. Can groundwater become surface water in
4 a Karst topography as we see used in this study?

5 MR. BURNS: Object to form. 09:29AM

6 A Groundwater does become surface water once it
7 reaches the stream. It becomes the base flow that
8 you see in our streams.

9 Q This isn't the first study to recognize the
10 connection between surface water and groundwater, is
11 it, to your knowledge? 09:29AM

12 MR. VARADY: I'm going to object to that.

13 A There are textbooks written on the connection
14 between surface and groundwaters.

15 Q So it's been known for some time; is that a
16 fair statement? 09:29AM

17 A As far back as the textbooks go, yes, sir.

18 Q And do you have an estimate of that time
19 frame?

20 A No, I don't. 09:29AM

21 Q Based on this statement then, does -- what
22 does that mean will happen to the nutrients,
23 bacteria or trace metals found in poultry litter
24 when applied to surface in a Karst topography?

25 MR. BURNS: Object to form. 09:30AM

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1 MR. VARADY: I object as well.

2 A That would require an extensive knowledge of
3 the actual site where the applications occurred.

4 Q Okay, and generally you don't know what might
5 happen from your study and research and experience?

09:30AM

6 A In general, if there are Karst features, the
7 surface water can enter into that and then flow more
8 directly into the groundwater.

9 Q And would those waters, when they flow into
10 the groundwater, take with them things found or
11 applied to the surface?

09:30AM

12 MR. VARADY: I object again. It's a
13 hypothetical question that he's not been retained as
14 an expert to opine on in this case.

15 Q Based upon your studies --

09:30AM

16 MR. VARADY: Just a minute. Let me make my
17 objection, please. It doesn't matter. That's a
18 hypothetical question. The fact that he's studied
19 it, that's not a question about the study.

20 MR. GARREN: It could very well be. So I'm
21 not going to argue with you, but you've made your
22 objection.

09:31AM

23 Q Based upon your study, research and
24 experience, have you found whether or not surface
25 waters will carry chemical elements with them, such

09:31AM

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1 as phosphorus, nitrogen, into the groundwater?

2 MR. BURNS: Object to form.

3 MR. VARADY: I object as well.

4 A My studies generally stopped at the runoff of

5 water from plots and have not had a component in

09:31AM

6 them to where I could have evaluated their movement

7 into the groundwater.

8 Q When you're studying streams, as a hydrologist

9 in your previous work, were you studying those

10 streams for chemicals such as phosphorus and

09:31AM

11 nitrogen?

12 A Yes, sir.

13 Q And in those studies and your research in that

14 work, did you make any attempt to find where those

15 chemical elements entered the stream or how they

09:31AM

16 entered the stream?

17 MR. BURNS: Object to form.

18 A We evaluated how much of the nutrients were

19 transported during either low flow, base flow

20 conditions or estimated how much were transported

09:32AM

21 during the high flow or storm event conditions.

22 Q And were the concentrations different than

23 those two examples?

24 A Yes.

25 Q Of phosphorus? Let's just use phosphorus, for

09:32AM

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1 example.

2 A Yes.

3 Q And is it commonly known in the scientific

4 community that in high flow that that phosphorus

5 elevation that you see when you measure in the

09:32AM

6 stream comes from surface runoff?

7 MR. BURNS: Object to form.

8 MR. VARADY: I'm going to object, Mr.

9 Garren. You're asking him to give expert testimony.

10 You've got your own expert who can answer that

09:32AM

11 question for you. That's not based on a study that

12 he's done here before him to answer questions about.

13 He's a fact witness. You can answer to the extent

14 you can.

15 A There are many sources during the high flow

09:33AM

16 events, both surface runoff and resuspension of

17 elements from within the stream channel.

18 Q Okay. My question was, is it commonly known

19 in the scientific community that in high flow events

20 that phosphorus elevations you see come from

09:33AM

21 surface?

22 MR. VARADY: Object again. You're asking

23 him as a scientific expert that question, Mr.

24 Garren.

25 A And I'm going to stick with the same answer,

09:33AM

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1 is that during the high flows there are many sources
2 of phosphorus, including resuspension from within
3 the stream channel, as well as surface runoff from
4 the landscape.

5 Q And I understand the concept, but what I'm
6 asking is a little bit different. In your study and
7 research, is it commonly known in the scientific
8 that that occurs, that phosphorus is transported off
9 the surface to those streams?

09:33AM

10 MR. BURNS: Object to form.

09:34AM

11 A Phosphorus is transported in surface runoff to
12 streams.

13 Q Okay. We've got a notice to change tapes.
14 This is your first break.

15 VIDEOGRAPHER: We are now off the Record.
16 The time is 9:33 a.m.

09:34AM

17 (Following a short recess at 9:33 a.m.,
18 proceedings continued on the Record at 9:41 a.m.)

19 VIDEOGRAPHER: We are back on the Record.
20 The time is 9:41 a.m.

09:41AM

21 Q Dr. Haggard, let me direct your attention to
22 Page 1016 on this study, and it's the next to the
23 last paragraph. I'm going to go through the whole
24 paragraph, but let's just break it down a sentence
25 at a time and it will be easier. The tendency for

09:42AM

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1 increased annual runoff losses of some soluble trace
2 metals, particularly arsenic, iron and selenium,
3 after repeated broiler litter application is
4 somewhat alarming. Is that -- that was a true
5 statement when this was written, was it not?

09:42AM

6 A Yes.

7 Q And tell the court just briefly why is it
8 alarming.

9 A I believe the intent there was that we are
10 seeing measurable concentrations of those elements.

09:42AM

11 Q Is this your first opportunity to measure
12 these elements in your study and research?

13 A I believe this was our first publication. I'm
14 not 100 percent sure. There are subsequent ones
15 that -- where we've looked at trace elements in
16 poultry litter extracts.

09:42AM

17 Q Okay. This was published technically in 2009,
18 was it not, yes. Okay. The next sentence in the
19 same paragraph goes on to say, the exposure to the
20 environment of increasing metal concentrations, and
21 their subsequent mobility either relatively quickly
22 due to runoff or somewhat more slowly, but
23 eventually due to leaching, is an important
24 environmental consequence of the land application of
25 broiler litter that cannot be ignored and requires

09:43AM

09:43AM

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1 further monitoring. Again, was that a true
2 statement at the time this was written?

3 A Yes.

4 Q All right, and are there -- did you measure
5 other -- let me back up. Was leaching measured in
6 this particular study or was it the kind of the
7 spinoff study by Pirani?

09:43AM

8 A It was the study by Pirani.

9 Q Okay. So I'd have to look at that to find
10 what was measured at this time but reported
11 differently in a different paper?

09:43AM

12 A Yes, sir.

13 Q Okay. What -- what further monitoring is it
14 you're saying needs to be done? When you say
15 requires further monitoring, what is it you expect
16 that to be?

09:44AM

17 A The intent of that sentence is to say that we
18 do need to keep monitoring leaching losses.

19 Q Okay. The phosphorus buildup in the soil that
20 you've commented on in this statement, in particular
21 that came off the control field, is -- can that
22 occur from just over application of poultry litter?

09:44AM

23 MR. BURNS: Object to form.

24 MR. VARADY: I'm going to object as well.

25 A The application of any source of nutrients can

09:45AM

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1 lead to the buildup of those within the soil.

2 Q So it's not just peculiar to phosphorus; is
3 that what you're telling me?

4 A Or to any individual source. Commercial
5 fertilizer would behave similarly as well.

09:45AM

6 Q Does the phosphorus buildup occur because the
7 plant or the crop is unable to uptake it and use it
8 in its growing process?

9 MR. BURNS: Object to form.

10 A It does occur because it is applied in excess
11 of the plants' needs.

09:45AM

12 Q Okay. The thesis -- I assume there's a thesis
13 that came as a result of Menjoulet's work in this
14 case?

15 A Yes, sir.

09:46AM

16 Q Did you sign that thesis?

17 A Yes, sir.

18 Q Okay. What does it mean when you sign a
19 thesis?

20 A That that student has successfully defended
21 her research.

09:46AM

22 Q And when you say successfully defended, who is
23 she defending against?

24 A She is defending against questions from her
25 masters committee.

09:46AM

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1 Q Okay. In this case that would have been who;
2 do you remember?

3 A I believe the author list would probably
4 denote Dr. Gbur, myself, Dr. Brye, and honestly I
5 don't remember who the other departmental members
6 were on this committee.

09:46AM

7 Q Okay. Let me hand you what's been marked as
8 Exhibit 3, Dr. Haggard, and ask you again if you
9 could identify that document.

10 A Yes, sir, I can. This is a publication by
11 Mansoor Leh, a graduate student in the department
12 that I'm housed in.

09:47AM

13 Q Were you one of the investigators in this
14 study?

15 A Yes. I was a co-investigator.

09:47AM

16 Q And you were also then a co-author; is that
17 correct?

18 A Yes, sir.

19 Q Did you read and approve the content of the
20 paper prior to its publication?

09:47AM

21 A Yes, I did.

22 Q Were the opinions, findings and conclusions
23 made by you in this paper accurate and true at the
24 time they were made?

25 A As best of my knowledge.

09:47AM

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1 Q Are there any facts or events that would cause
2 you to change any of the opinions, findings or
3 conclusions in this paper at this time?

4 A Not to my knowledge.

5 Q Are you aware of any other published papers
6 who have criticized the data compiled in this study?

09:47AM

7 A No, sir, I'm not.

8 Q Are you aware of any other published papers
9 that have criticized the methodology used in this
10 study?

09:48AM

11 A No, sir, I'm not.

12 Q Look in the abstract and tell me, sir, I think
13 the second sentence says it, I'll go ahead and read
14 it. The objective of the study was to use a field
15 scale approach to delineate critical runoff source
16 areas and to determine the runoff mechanisms in a
17 pasture hill slope of the Ozark Highlands in the
18 USA. Did you work in the field in this study
19 research?

09:48AM

20 A No, sir, I did not specifically do any of the
21 field work.

09:48AM

22 Q All right. Did you go to the field and
23 observe how it was set up?

24 A Yes, sir.

25 Q The location is listed as the Savoy

09:48AM

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1 experimental watershed, which is northwest of -- in
2 the northwest part of Arkansas. That's a different
3 location than we talked about from the previous
4 study in Exhibit 2; correct?

5 A Yes, sir.

09:49AM

6 Q And was this study using actual fields as
7 opposed to smaller plots?

8 A Yes, sir. It used a pasture hill slope.

9 Q All right, and I've deposed Dr. Chaubey, and
10 I'm familiar with some of his work in this area. So
11 is this the same plot area or field area where he
12 conducted his infiltration saturation studies with a
13 significant amount of instrumentation on the hill
14 slope; do you remember?

09:49AM

15 A This is the site where he had surface runoff
16 sensors to determine if surface runoff was occurring
17 and subsurface sensors to see if the soil was
18 saturated up to the soil-air interface.

09:49AM

19 Q Were those same sensing instrumentation
20 mechanisms in place for this study?

09:50AM

21 A Yes, sir, I believe so.

22 Q Okay. Is this then sort of a continuation of
23 the study that he performed before leaving the
24 University of Arkansas?

25 A I believe this is a publication of that study.

09:50AM

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1 Q Okay. What was the overall goal of the study,
2 if you would, please?

3 A We were trying to determine whether runoff --
4 which runoff mechanism produced runoff, whether it
5 was infiltration excess or saturation excess.

09:50AM

6 Q Was -- was the overall goal of the objective
7 accomplished in this study?

8 A It was.

9 Q And what was the dominant runoff mechanism
10 determined from this study?

09:50AM

11 A Let me review the document, please.

12 Q All right.

13 A This study showed that both infiltration and
14 saturation excess runoff is occurring, and that zero
15 to 58 percent of the runoff was from infiltration
16 excess, whereas zero to 26 percent was from
17 saturation excess.

09:51AM

18 Q Okay. In this study then am I correct in
19 saying that both surface and subsurface field and
20 watershed characteristics were being measured?

09:51AM

21 A Yes, sir.

22 Q All right. Is the land use of the Savoy
23 experimental watershed representative of typical
24 pasture-dominated agricultural fields in the Ozark
25 Highlands?

09:52AM

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1 A It is representative of that region.

2 Q All right. Look at -- they're not numbered.

3 It's the next to the last page, it looks like, at

4 the bottom of your summary and conclusions section,

5 and the last sentence, it says, this methodology

09:53AM

6 provides a detailed procedure for capturing the

7 hydrologic activities that occur on a hill slope and

8 provides benchmark procedures that can be used in

9 locating areas for best management practice

10 implementation. Did I read that correctly?

09:53AM

11 A Yes, sir, you did read it correctly.

12 Q Were you able in this study to accurately

13 identify and describe the hydrologic activities

14 occurring at the Savoy study site?

15 A At this particular hill slope, we were able to

09:53AM

16 determine where infiltration and saturation excess

17 did occur.

18 Q How -- how -- well, I think you've answered

19 this. In the -- in the same paragraph it says that,

20 midway down, the infiltration excess runoff

09:54AM

21 mechanisms -- mechanism areas were located primarily

22 in areas of high soil electrical resistance, while

23 saturation excess mechanisms -- mechanism areas were

24 located in subsurface fractures. What does it mean

25 by electrical resistance?

09:54AM

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1 A I have to admit that I'm not an expert in the
2 use of these geophysical tools to determine that.

3 Q Okay. Go further up then in the summary and
4 conclusions. The second sentence, it says, results
5 from this study showed that both infiltration excess
6 and saturation excess runoff processes occurred on
7 this hill slope. Let's talk about those two
8 concepts. Saturation basically is what to a layman;
9 how do you describe that?

09:55AM

10 A The soil would be full of water.

09:55AM

11 Q All right.

12 A Would be saturation.

13 Q And so when rain hits soil that's full of
14 water, what happens?

15 A The rainfall cannot infiltrate to the soil, so
16 it runs off.

09:55AM

17 Q Okay. Let's talk about the other process,
18 infiltration. What is infiltration from a layman's
19 standpoint?

20 A It is the movement of water through the soil
21 profile.

09:55AM

22 Q And what happens in that circumstance where
23 the rainfall would actually run off; what's
24 occurring?

25 A Generally the rainfall rate has exceeded the

09:55AM

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1 infiltration rate, so not all of the water can move
2 into the soil, and a portion of it runs off.

3 Q All right. So you've got two processes that
4 you've identified that allow rainfall to run off a
5 field; is that a correct statement? 09:56AM

6 A Yes, sir.

7 Q Okay. For purposes of this study and the
8 methodology that was to help in best management
9 practices, did you attempt to identify areas of this
10 hill slope where runoff actually occurs then? 09:56AM

11 MR. BURNS: Object to form.

12 A The site was instrumented, such that we would
13 know where surface runoff was occurring.

14 Q Was part of the purpose in this study to
15 identify those parts of the field that either are
16 more or less susceptible to runoff? 09:56AM

17 A Yes. We identified the parts of the field
18 that -- where runoff occurred under different
19 precipitation events that occurred throughout the
20 time period of the study. 09:57AM

21 Q Look back a page and there's -- actually the
22 next two or three pages. We have various figures in
23 here that show these hill slope plots; correct?

24 A Yes, sir.

25 Q And those are designated or identified as to 09:57AM

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1 the areas of the plots and how the particular
2 process was occurring; is that correct?

3 A Yes, sir.

4 Q Okay. Are you aware if there had been
5 previous studies looking at delineating runoff
6 surface waters in watersheds?

09:57AM

7 A Could you repeat the question?

8 Q Yeah. Are you aware if there were previous
9 studies that looked at delineating runoff surface
10 areas in a watershed besides this one?

09:57AM

11 A Yes.

12 Q You cite to an author named Dunne, D-U-N-N-E.
13 Is that one of them; do you recall?

14 A I would have to look at the reference list.

15 Q Okay.

09:58AM

16 A In the reference list we do cite Dunne and
17 Black papers from the 1970s.

18 Q Good. Thank you. What is important from this
19 study about delineating runoff surface areas?

20 A To understand what mechanisms are producing
21 the runoff that's leaving the hill slope.

09:58AM

22 Q Does that assist you and/or others in
23 identifying areas where runoff may be more likely to
24 occur from a particular site?

25 A That obviously assisted us in determining that

09:58AM

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1 from this hill slope.

2 Q Is that the purpose, though, when you comment
3 about this is a good methodology to help in BMP
4 implementation; was that the goal in a sense?

5 A The goal of this was -- this was funded 09:59AM
6 through the USDA NRI program, and it was to
7 demonstrate that the methodology can work in
8 northwest Arkansas, and to show that it could be
9 applied to other fields to delineate what's -- where
10 saturation excess occurs or where infiltration 09:59AM
11 excess occurs.

12 Q Okay. This may be a question of the obvious,
13 but to do that at a different location, in your
14 opinion, does it require all that instrumentation to
15 be set up as was done in this study? 09:59AM

16 A It does not have to be as high density a
17 setup.

18 Q As was used in this study?

19 A As was used in this study.

20 Q Okay. Let's look at the first page again of 09:59AM
21 your paper, and the next to the last or the last
22 paragraph in the left-hand column, the second
23 sentence, it says, for example, storm runoff plays a
24 major role in phosphorus transport, and diffuse
25 phosphorus pollution is a major contributor to 10:00AM

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1 freshwater systems. Is that a true statement when
2 it was written for this report?

3 A Yes, sir.

4 Q Is there anything that's occurred since the
5 writing of that statement that would change your
6 opinion about the truth of that statement?

10:00AM

7 A No. Storm runoff does play a role in
8 phosphorus transport.

9 Q The very first sentence under introduction, it
10 says, storm runoff generation is a non-linear
11 process that has surface and subsurface components.

10:00AM

12 What does that mean to a layman that it's a
13 non-linear process, not what it means to a layman,
14 but how can you explain it to a layman?

15 A To understand the intent of that sentence, it
16 would be best to ask the primary authors, either
17 Mansoor Leh or Dr. Chaubey.

10:01AM

18 Q Okay. That's fine. I need to ask you about
19 another word in the report, and these aren't
20 numbered, but it's actually the sixth page of the
21 document I believe.

10:01AM

22 A Okay.

23 Q And right here where it says, at Savoy, as in
24 numerous Karst areas elsewhere, characterized by
25 heterogeneous and anisotropic pathways that

10:02AM

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1 underdrain the soil. What is anisotropic pathways;
2 what does that mean?

3 A I don't know. No, sir. I would ask Dr. Van
4 Brahana.

5 Q All right. Let me hand you Exhibit No. 4 and
6 ask you if you can identify it.

10:02AM

7 A This is a paper that I wrote.

8 Q As published in July of '03, is that correct,
9 through the Biosystems Engineering?

10 A Yes, sir.

10:02AM

11 Q Okay. When you're the first author, does that
12 make you the principal investigator also when you
13 see a published paper like this?

14 A Generally that's how it works, yes, sir.

15 Q All right, and did you read and approve the
16 content of the paper prior to its publication?

10:02AM

17 A Yes, sir.

18 Q Are the opinions, findings and conclusions
19 made by you in this paper accurate and true at the
20 time you made them?

10:03AM

21 A Yes, sir.

22 Q Are there any facts or events that would cause
23 you to change any opinions, findings or conclusions
24 that you made in this paper that you know of?

25 A Not that I'm aware of.

10:03AM

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1 Q Are you aware of any other studies that have
2 criticized the data compiled in this study?

3 A No, sir.

4 Q Are you aware of any others who have
5 criticized the methodology used in the study?

10:03AM

6 A No, sir.

7 Q In the abstract, what appears to be the third
8 sentence, it says, nitrogen and P concentrations
9 were measured in four subwatersheds of Beaver Lake,
10 a reservoir in the White River in Arkansas, USA, to
11 assess possible relationships between pastureland
12 use and stream nutrient concentrations and export.

10:03AM

13 Did I read that correctly?

14 A Yes, sir.

15 Q And was that generally the object of this
16 study?

10:03AM

17 A Yes, sir.

18 Q When you completed the study, did you feel
19 that your objectives were accomplished?

20 A To the extent that the data statistically
21 supported it, yes, sir.

10:04AM

22 Q Okay, and did you feel that the data did
23 statistically support it?

24 A The conclusions we made, yes, sir.

25 Q Okay. Do you, sir, know whether or not --

10:04AM

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1 first off, where is the Beaver Lake watershed in
2 relation to the Illinois River watershed; do you
3 know that?

4 A It is east.

5 Q Do they abut each other or adjoin each other?

10:05AM

6 A They are adjacent watersheds.

7 Q Okay. Are the Beaver Lake and IRW each in
8 what's considered the Ozark Highlands?

9 A Yes, sir, in that general ecoregion.

10 Q All right. Are there poultry operations in
11 the Beaver Lake watershed?

10:05AM

12 A Yes, sir.

13 Q You state on the first page in the lower
14 right-hand corner that the issue of NPS, and that
15 would be non-point source nutrient loading; is that
16 correct?

10:06AM

17 A Yes, sir.

18 Q Has come into sharp focus in the state of
19 Arkansas in the last ten years due to the rapid
20 growth of the poultry industry. Was that a true
21 statement at the time you made this in 2003?

10:06AM

22 A Yes, sir.

23 Q Okay. Did you make a determination what was
24 done with most of the poultry litter that is
25 generated from the poultry growing operations in the

10:06AM

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1 Beaver Lake watershed?

2 MR. BURNS: Object to form.

3 A We assumed that it was land applied.

4 Q And what was the basis for your assumption?

5 A The general practices that are used where 10:06AM
6 poultry litter is used to fertilize fields.

7 Q What is it about the rapid growth of the
8 poultry industry that caused focus on nutrient
9 loading?

10 MR. BURNS: Object to form. 10:07AM

11 A The increased number of poultry operations
12 could suggest that you could have increased amounts
13 of poultry litter applied to the landscape, and so
14 we wanted to focus on -- that's why the shift of
15 focus was to non-point source pollution. 10:07AM

16 Q Okay. Has the import of phosphorus and animal
17 feeds resulted in a substantial accumulation of
18 phosphorus within the watershed, such as Beaver or
19 Illinois River watershed, where there are high
20 densities of confined poultry operations? 10:07AM

21 MR. VARADY: I object to the form.

22 A I don't have knowledge of how the
23 concentrations in the soils have changed over time
24 within that basin.

25 Q Okay. Do you remember writing a paper in 2003 10:08AM

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1 that basically was P sources in Ozark catchment,
2 have we forgotten P from discrete sources?

3 A Yes, sir.

4 Q Do you remember making the statement that
5 import of phosphorus in animal fields resulted in a
6 substantial accumulation of P within the watershed
7 in that statement, in that report?

10:08AM

8 A I would like to review that to see the context
9 that it was written in.

10 Q Okay. Tell the court, if you would, please,
11 generally what you did in this study.

10:08AM

12 A We collected water samples at I believe ten
13 sites approximately seventeen times annually at a
14 predetermined interval.

15 Q And what were you -- were you sampling just
16 streams, groundwaters or what?

10:09AM

17 A In this study we were sampling just streams
18 during both base flow conditions and high flow
19 events.

20 Q All right. Look at on Page 76 the left-hand
21 column. Looks to be the first or second full
22 sentence down, starting the environmental
23 consequences; do you see that sentence?

10:09AM

24 A Yes, sir.

25 Q Okay. The environmental consequences of N,

10:10AM

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1 nitrogen-based applications included high loads of
2 phosphorus, heavy metals and organic compounds in
3 runoff and eventually in the receiving freshwater
4 ecosystems. Was that statement true at the time you
5 wrote it?

10:10AM

6 A Yes, sir.

7 Q Is there anything that would make you think
8 that was not true today?

9 A Not that I'm aware of.

10 Q Okay. Do you know when P-based or
11 phosphorus-based nutrient plans were mandated in
12 Arkansas?

10:10AM

13 MR. BURNS: Object to form.

14 A Early 2000s.

15 Q Okay. If I told you 2006, would that refresh
16 your recollection of mandated nutrient management
17 plans?

10:11AM

18 A I thought --

19 Q It doesn't matter.

20 A If that's the date you have, but I thought it
21 occurred earlier than that, but that could be
22 correct.

10:11AM

23 Q Based upon your research in the Illinois River
24 watershed and Beaver Lake watershed, do you consider
25 them similar in geology?

10:11AM

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1 MR. BURNS: Object to form.

2 MR. ELROD: Object to form.

3 A I do not know if they are similar in the
4 underlying geology.

5 Q Okay. Did you -- do you know whether or not 10:11AM
6 they both contain Karst geology?

7 A I believe there's a higher proportion in the
8 Illinois River basin.

9 Q Okay. Did you make any determination whether
10 their land uses are similar, that is, the Beaver 10:12AM
11 Lake watershed and the Illinois River watershed?

12 MR. BURNS: Object to form.

13 MR. VARADY: Object to the form. Are you
14 asking about a specific study that he did?

15 Q Based upon the studies you've done in the 10:12AM
16 Illinois River watershed and the study that you did
17 in Beaver Lake, did you observe whether the land
18 uses were similar in those watersheds?

19 A The major land uses are similar, which would
20 be urban, pasture and forest. 10:12AM

21 Q Did you for purposes of your study in the
22 Beaver Lake attempt to quantify the amount of
23 pasture, urban, forested areas by percentages or
24 anything?

25 A We did delineate that with GIS, yes, sir. 10:12AM

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1 Q All right, and it would be in your report;
2 correct?

3 A Yes, sir.

4 Q Okay. Let me ask you this just generally: In
5 particular you cited a report, but when you cite a
6 report in a paper like this that you've drafted and
7 published, do you read those reports before you cite
8 them?

10:13AM

9 A Yes, sir.

10 Q Okay. So you know what they studied, you know
11 what they did to study it and what they concluded
12 before you entered it as a citation in your own
13 report; correct?

10:13AM

14 A I do my best to understand the intent of the
15 study, yes, sir.

10:13AM

16 Q Okay. Let's move over to Page 82 in this
17 exhibit, please, in the right-hand column. It says
18 that about midway down the right-hand column, the
19 first paragraph, however, nutrient yields in these
20 subbasins also increase exponentially with the
21 proportion of pasture. Tell the court and jury what
22 that means.

10:15AM

23 A That with the four basins that were monitored
24 in this site, that the greater the percent pasture,
25 the greater the export of phosphorus, but that was

10:15AM

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1 also related to watershed size as well.

2 Q Okay. Let's break that down a little bit.

3 When you say the export of phosphorus, what does
4 that mean; export from what?

5 A That's measuring it in terms of kilograms per 10:15AM
6 year within the stream.

7 Q Okay, and when you -- you said there were four
8 basins. Are these smaller subbasins within the
9 Beaver Lake watershed that we're studying?

10 A Yes, it is four basins. It would be Brush 10:16AM
11 Creek, War Eagle Creek, Richland Creek and the White
12 River.

13 Q Okay. So I apologize. Just a second. I'm
14 trying to find a quotation here. Look back at the
15 abstract, sir, if you would, please, and about five 10:17AM
16 or six lines up from the bottom, there's a sentence
17 that says, nutrient yield was from three times to
18 over ten times greater than nutrient yields observed
19 in regional undeveloped streams and the average of
20 the hydrologic benchmark network of the U. S. 10:17AM

21 Geological Survey. Let me ask you a little bit
22 about that. First off, what regional undeveloped
23 streams were used for comparison, if you recall?

24 A I believe it was the Cossatot River and North
25 Sylamore Creek. 10:17AM

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1 Q And are those subbasins unimpacted by poultry
2 operations; do you know?

3 A To my knowledge, they are predominantly
4 forest, forested areas.

5 Q All right. So when this says that the
6 nutrient yield in the basins that you are reporting
7 on was three to ten times greater, what does that
8 tell you about where the nutrients are coming from?

10:18AM

9 A That the change of land use from forest to
10 urban and pasture has increased the nutrient export.

10:18AM

11 Q Okay. How much urban area were in the four
12 subbasins that you studied in this Beaver Lake
13 report?

14 A I would have to look back at the table to
15 describe the land use.

10:18AM

16 Q Do you know where that is in the paper?

17 A No, sir, I don't. Table 1 on Page 78. It's
18 not explicitly listed there, but it would be the
19 difference between 100 percent minus the percents of
20 pasture and forested land should approximately
21 represent the urban land use within that catchment.

10:19AM

22 Q Okay. So that I understand you, the first
23 line, the Upper War Eagle Creek, if you add the
24 pasture and forest together, you get 97 percent, so
25 the urban would be the remaining 3 percent?

10:19AM

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1 A Yes, sir.

2 Q Was there -- were you able to determine
3 whether or not there was any dependence of the
4 phosphorus from land use -- from urban land use
5 versus pasture?

10:20AM

6 A I do not explicitly remember comparing that in
7 this paper.

8 Q When we talked earlier about the exponential
9 increase of three to ten, tell the court what that
10 means and the jury for a layperson to understand.
11 We talked earlier about 3 to 10 percent, do you
12 remember that statement?

10:20AM

13 A Yes, sir. It said nutrient yield was from
14 three times to ten times greater than nutrient yield
15 in regional undeveloped streams and the average of
16 the hydrologic benchmark network.

10:20AM

17 Q Okay, and then it said that nutrient yields in
18 the subbasin increased exponentially in the pasture.
19 What does exponentially mean in that sense?

20 A It's a non-linear increase.

10:20AM

21 Q Okay. Did you at any time attempt to quantify
22 nutrient yields in the Illinois River watershed as
23 was done in the Beaver Lake watershed?

24 A Yes, I have estimated nutrient yields at the
25 Illinois River at Highway 59.

10:21AM

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1 Q Okay. Look at Page 82 of your report in the
2 lower right-hand corner. Go ahead and read the --
3 not out loud but just read and familiarize yourself
4 with what's in the paragraph down to line nutrient
5 yields are also about half of that observed in the
6 Illinois River basin, and I'll ask you about it.

10:21AM

7 A Yes, sir.

8 Q Am I understanding this correct then that the
9 nutrient yields in the Beaver Lake study area were
10 about half of that of what is observed in the
11 Illinois River basin from '97 to '99 in a prior
12 study that you reported on; is that correct?

10:22AM

13 A Yes, sir. The nutrient loads in Beaver Lake
14 from '93 to '95 when that data was collected was
15 half of what the load was from '97 to '99 in the
16 Illinois River basin.

10:22AM

17 Q Okay. Tell the court what is the hydrologic
18 benchmark network that you reference in your report.

19 A That is a system of USGS discharge monitoring
20 stations that their -- the USGS' intent is to have
21 sites that represent predominantly undeveloped
22 catchments.

10:23AM

23 Q Are any of those sites in northwest Arkansas?

24 A The two that I referenced earlier, yes, sir.

25 Q Okay, very good. In Page 84 of your report,

10:23AM

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1 which is the upper left-hand column, second or
2 third -- about six lines down. It says, this
3 investigation emphasized the need to carefully
4 manage poultry litter because small losses of
5 nutrients compared to the total amount of nutrients
6 produced in a basin may still impact stream nutrient
7 concentrations and export. Was that statement true
8 when you made it then?

10:24AM

9 A Yes, sir.

10 Q Do you believe that statement to be true
11 today?

10:24AM

12 A Yes, sir.

13 Q Is there anything that's occurred that would
14 cause you to change this opinion as expressed in
15 this study?

10:24AM

16 A Not that I'm aware of.

17 Q Okay. Have you had any experience, sir -- I'm
18 going to change subjects on you -- to study in the
19 Eucha-Spavinaw Lake watershed?

20 A Yes, sir.

10:24AM

21 Q Okay. When did you have experience working
22 and studying in the Eucha-Spavinaw watershed?

23 A The Tulsa Metropolitan Utility Authority and
24 the City of Tulsa funded my dissertation research
25 when I was at Oklahoma State University.

10:25AM

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